6.3471



L. W. Camp
Director
Automotive Safety Office
Environmental And Safety Engineering

Ford Motor Company
330 Town Center Drive
Dearborn, Michigan 46126 USA

April 22, 1999

Kenneth R. Wykle
Administrator
Federal Highway Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

Dear Mr. Wykle

FHWA-99-5867-6
FHWA-99-5880-7

Re: Exemption Request Submitted Pursuant to 49 CFR Part 381 - Waivers, Exemptions, and Pilot Programs

Ford Motor Company (Ford), with offices at The American Road, Dearborn, Michigan 48121-1899, hereby requests exemption from Federal Motor Carrier Safety Standard 49CFR Part 393.67 (c)(7)(ii), Fill Pipe Filling Rate. The exemption is being sought for Ford Motor Company Vehicles manufactured with non-side mounted fuel tanks.

The following information is provided in accordance with Part 381.310, How do I apply for an exemption:

(b)(1) This exemption request is being submitted by:

L. W. Camp
Director, Automotive Safety Office
Environmental & Safety Engrg., Ford Motor Company

Fairlane Plaza South, Suite 400
330 Town Center Drive
Dearborn, Mi. 48126

(b)(2) This request is being submitted by Ford Motor Company on behalf of customers that operate Commercial Motor Vehicles based off of our Ford Econoline incomplete chassis.

(b)(3&4) Since this exemption request is targeted at a particular type of vehicle, it is impossible to identify all operators, operators addresses, and USDOT identification numbers for the affected population. Vehicles involved can be identified by the Vehicle Identification Number (VIN) which contains the following codes in the 5th, 6th, and 7th positions:

E30, E37, E39, E40, E47

(c)(1) Ford Motor Company produces Econoline incomplete vehicles which are completed by second unit body manufacturers for a multitude of uses, including use as Commercial Motor Vehicles (CMVs). Our customers operating Econolines as CMVs will require fuel tanks that meet the requirements of 49 CFR Part 393.67, Liquid Fuel Tanks. To enable our customers to use Econoline vehicles as CMVs, without retrofitting the fuel tanks, Ford Motor Company has performed testing on the original equipment fuel tanks to verify compliance with Part 393.67. In doing so, it was discovered that fuel systems in the gasoline version could not achieve the performance requirements of Part 393.67(c)(7)(ii), Fuel Filling Rate. Diesel versions were found to comply fully with the 20 gallon per minute minimum filling rate.

The 20 gallon per minute fill rate requirement is relatively easy for a vehicle with side mounted fuel tanks as the filler system is no more that a short (approximately 2") piece of large diameter pipe. The Econoline vehicle line utilizes a fuel tank mounted "between the frame rails" which utilizes a longer filler system that is strategically routed to minimize exposure in the event of a crash. This results in a filler system that is approximately 2 feet long with several bends resulting in additional internal resistance to fuel flow. When these attributes are combined with the high vapor generated when filling with gasoline fuel, the maximum filling rate is reduced. This particular vehicle line was found to perform effectively at rates up to 17 gallons per minute.

For the reasons detailed above, the gasoline version of the Econoline fuel system requires an exemption from the minimum filling rate of Part 393.67(c)(7)(ii). Ford Motor Company requests that this exemption apply for the maximum time period allowed under 49 CFR Part 381.

(c)(2) This exemption is from the requirements of 49 CFR Part 393.67(c)(7)(ii).

(c)(3) It is not possible to identify exactly the total number of Econoline based vehicles that will be used by customers as CMVs. Of the 19,000 applicable Econoline vehicles produced each model year, 13,000 are produced in the gasoline fuel configuration and some percentage of these would be used as CMVs.

(c)(4&5) It is difficult to address Part 393.67(c)(7)(ii) as a safety requirement. Ford views this portion of Part 393 to be more a subject of convenience. With virtually all filling stations using the industry standard automatic shut-off nozzles, it is unlikely that fuel will be spilled even while using a high flow rate delivery system. These standard nozzles substantially reduce any potential safety risk introduced by filling an Econoline vehicle at a rate above its capacity of 17 gallons per minute.

Further, the U.S. Environmental Protection Agency (EPA) has imposed a 10 gallon per minute limit[1] on gasoline fuel flow rates at any "retailer or wholesale purchaser-consumer". This EPA requirement was effective in part on January 1, 1996 and in full on January 1, 1998. As mentioned previously, the Econoline fuel fill system can easily accommodate this fill rate.

[1] EPA 40 CFR Part 80.22 (j)

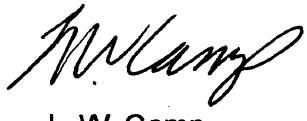
With the combination of a Federally enforced maximum fuel delivery rate and the standard use of automatic shut-off delivery nozzles, Ford Motor Company believes that there should not be a negative safety effect of these vehicles not complying with Part 393.67 (c)(7)(ii).

(c)(6) The Econoline incomplete vehicle offers users a vehicle that is based on a "light truck" platform with load carrying capability that places it into the CMV classification. It fits a need for a "light duty" CMV that allows users to carry large loads without the need for a "heavy truck" that is more expensive to purchase and operate.

The demand for these Econoline vehicles is so strong that, if this exemption is denied, the industry would be forced to retrofit the fuel tank in those vehicles used as a CMV. Such modifications could undermine the integrity of the overall fuel system as validated by Ford Motor Company, potentially resulting in fuel systems that perform better at accepting extreme fill rates but worse in other aspects (durability, crash, etc.).

If there are any questions regarding this request for exemption, please contact Mr. Lindsay Harding of my staff at (313) 845-8639 /fax (313) 594-0723 or e-mail at lharding@ford.com.

Sincerely,



L. W. Camp

person shall be required to furnish information requested under this paragraph if he can establish that such information is not maintained in the normal course of his business.

(Sect. 211. 301. Clean Air Act, as amended (42 U.S.C. 1857f-6c, 1857g))

[40 FR 36336. Aug. 20. 1975. as amended at 42 FR 45307. Sept. 9. 1977: 47 FR 49332. Oct. 29. 1982; 61 FR 3837, Feb. 2. 19961

## Subpart B-Controls and Prohibitions

§§ 80.20-80.2 1 [Reserved]

§ 80.22 Controls and prohibitions.

(a) After December 31. 1995, no person shall sell, offer for sale, supply, offer for supply, dispense, transport, or introduce into commerce gasoline represented to be unleaded gasoline unless such gasoline meets the defined requirements for unleaded gasoline in §80.2(g); nor shall he dispense, or cause or allow the gasoline other than unleaded gasoline to be dispensed into any motor vehicle which is equipped with a gasoline tank filler inlet which is designed for the introduction of unleaded gasoline.

(b) After December 31, 1995, no person shall sell, offer for sale, supply, offer for supply, dispense, transport, or introduce into commerce for use as fuel in any motor vehicle (as defined in Section 216(2) of the Clean Air Act, 42 U.S.C. 7550(2)), any gasoline which is produced with the use of lead additives or which contains more than 0.05 gram of lead per gallon.

(c)-(e) [Reserved]

(f) Beginning January 1, 1996, every retailer and wholesale purchaser-consumer shall equip all gasoline pumps as follows:

(1) [Reserved]

(2) Each pump from which unleaded gasoline is dispensed into motor vehicles shall be equipped with a nozzle spout which meets the following specifications:

(i) The outside diameter of the terminal end shall not be greater than 0.840 inch (2.134 centimeters);

(ii) The terminal end shall have a straight section of at least 2.5 inches (6.34 centimeters) in length; and

(iii) The retaining spring shall terminate 3.0 inches (7.6 centimeters) from the terminal end.

(g)-(i) [Reserved]

(j) After July 1, 1996 every retailer and wholesale purchaser-consumer handling over 10,000 gallons (37,854 liters) of fuel per month shall limit each nozzle from which gasoline or methanol is introduced into motor vehicles to a maximum fuel flow rate not to exceed 10 gallons per minute (37.9 liters per minute). The flow rate may be controlled through any means in the pump/dispenser system, provided the nozzle flow rate does not exceed 10 gallons per minute (37.9 liters per minute). After January 1, 1998 this requirement applies to every retailer and wholesale purchaser-consumer. Any dispensing pump that is dedicated exclusively to heavy-duty vehicles, boats, or airplanes is exempt from this requirement.

(38 FR 1255. Jan. IO. 1973. as amended at 39 FR 16125. May 17. 1974: 39 FR 43283. Dec. 12. 1974: 48 FR 4287. Jan. 31. 1983: 56 FR 13768. Apr. 4. 1991: 58 FR 16019. Mar. 24. 1993: 61 FR 3837, Feb. 2. 1996: 61 FR 33039. June 26. 1996)

§80.23 Liability for violations.

Liability for violations of paragraphs (a) and (b) of §80.22 shall be determined as follows:

(a)(1) Where the corporate, trade, or brand name of a gasoline refiner or any of its marketing subsidiaries appears on the pump stand or is displayed at the retail outlet or wholesale purchaser-consumer facility from which the gasoline was sold, dispensed, or offered for sale, the retailer or wholesale purchaser-consumer, the reseller (if any), and such gasoline refiner shall be deemed in violation. Except as provided in paragraph (b)(2) of this section, the refiner shall be deemed in violation irrespective of whether any other refiner, distributor, retailer, or wholesale purchaser-consumer or the employee or agent of any refiner, distributor, retailer, or wholesale purchaser-consumer may have caused or permitted the violation.

(2) Where the corporate, trade, or brand name of a gasoline refiner or any of its marketing subsidiaries does not appear on the pump stand and is not

# 1963 SAE Handbook

All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to adhere to any SAE Standard or SAE Recommended Practice, and no commitment to conform to or be guided by any technical report.

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—SAE Technical Board Rules and Regulations

## SEMITRAILER BRAKE CONNECTION LOCATIONS—SAE J702

**SAE Recommended Practice**

Report of Motorcoach and Motor Truck Technical Committee approved September 1948 and last revised by Truck and Bus Technical Committee September 1956.

*Manual Type*

**Truck Tractor Fittings**—Fittings for connecting the coupling hose shall be located approximately 3 in. back of the cab and in any convenient location above the frame level. They should preferably be located from 3 to 9 in. on each side of the centerline of the chassis. See Figs. 1 and 2.

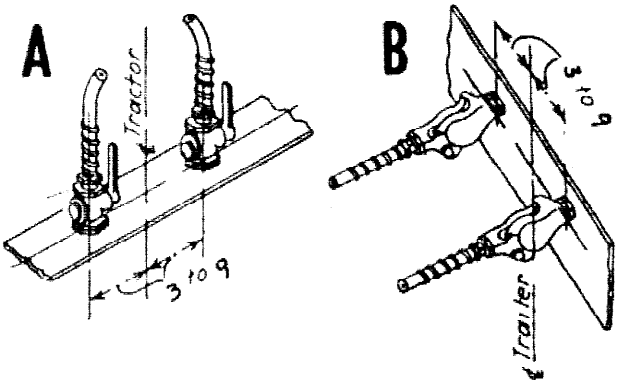


FIG. 1—AIR FITTINGS ON (A) TRUCK TRACTOR AND (B) SEMITRAILER

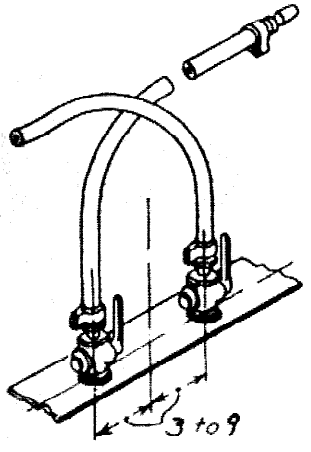


FIG. 2—VACUUM FITTINGS ON TRUCK TRACTOR (VERTICAL POSITION SHOWN, OTHER POSITION OPTIONAL)

**Semitrailer Fittings**—Fittings for connecting the operating hoses shall be located at the forward end of the semitrailer and approximately 3 to 9 in. on each side of the centerline of the trailer. Air hose connections should be equipped with hose coupling set, see Fig. 3, and vacuum brakes should have hose coupling set, see Fig 4, to insure interchangeability between various truck tractors and trailers.

NOTE: Care should be exercised in calculating hose lengths so that the hose equipment of the truck tractor will be of sufficient length to operate with manual or automatic trailer in the event that center distances of the fittings exceed the 9 in. dimension on either side of the centerline.

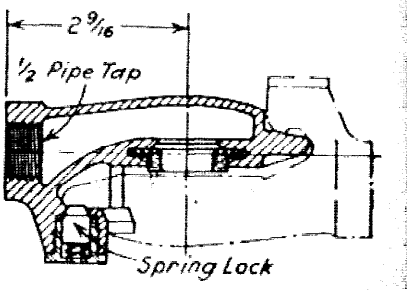


FIG. 3—AIR HOSE COUPLING

***Semitrailer Electrical Connection Location***

**Truck Tractor Connections** should be mounted on the centerline of the chassis behind the cab, approximately between the hose connections.

**Semitrailer Connections** should be mounted on the centerline of the trailer at the forward end, approximately between the hose connections.

NOTE: The location of the electrical connection in line horizontally with the hose connections will permit the operator to strap electrical cable to one or the other of the hose connections to prevent fouling when disconnected.

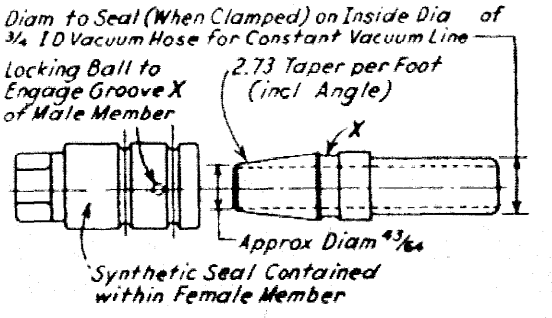


FIG. 4—VACUUM HOSE COUPLING

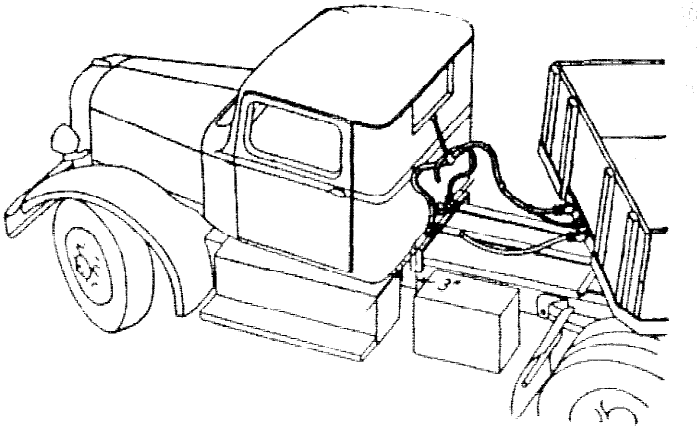

FIG. 5—LOCATION OF BRAKE HOSE AND ELECTRICAL CONNECTIONS

## FUEL SYSTEMS—SAE J703

**SAE Information Report**

Report of Truck and Bus Technical Committee approved October 1954. Reaffirmed without change January 1960.

This SAE Information Report consists of Section 193.65 of the Motor Carrier Safety Regulations of the Interstate Commerce Commission as amended September 22, 1953. It replaces the SAE Recommended Practice for Side Mounted Gasoline Tanks as revised in 1949.

*A—Fuel Container Location*—No part of any fuel tank or intake pipe shall project beyond the overall width of any motor vehicle upon which

it is mounted. No part of any fuel tank shall be located forward of the front axle of the power unit upon which it is located, except that this requirement shall not apply to trucks manufactured prior to September 30, 1953, which have a total fuel capacity of less than 20 gal, nor shall fuel be supplied to the engine of a bus, truck, or truck tractor from a fuel tank or container located on a semitrailer or full trailer.

***B—Fuel Container on Bus***—No part of any fuel tank or container or intake pipe shall be located within or above the passenger carrying portion of any bus unless securely sealed off from such compartment by means of a substantial metal cover. Except for buses having a seating capacity of eight or less persons and except those being transported in driveaway-towaway operations, the fuel containers, including intake pipe, caps, and vents on every bus, the date of manufacture of which is subsequent to September 30, 1953, shall be so designed that, in the event of overturn, the fuel will not be spilled at a rate in excess of 1 oz per min.

***C—Gravity or Syphon Feed Prohibited***—No fuel system on a motor vehicle shall be so constructed as to permit gravity or syphon feed direct to the carburetor or injector.

***D—Selector Valves***—If a motor vehicle is equipped with a selector control valve for fuel feed from two or more tanks, such valve shall be installed so that either (a) it is in normal reach of the driver so that he can readily operate it without taking his eyes from the road or moving from his customary driving position, or (b) the driver must stop the vehicle and leave his seat in order to operate the valve.

***E—Liquid Fuel Tank Requirements***

1. Every liquid fuel tank or container containing fuel for the propulsion of the motor vehicle shall be of substantial construction, free from leaks, and securely attached to the motor vehicle.

2. Replacement side mounted gasoline tanks, the date of manufacture of which is subsequent to November 30, 1953, on every motor vehicle, and side mounted gasoline tanks on every motor vehicle, the date of manufacture of which is subsequent to November 30, 1953, shall comply with the requirements of paragraphs F to K inclusive, of this section.

3. Replacement gasoline tanks, of the other than side mounted type, the date of manufacture of which is subsequent to November 30, 1953, unless constructed in conformity with the original tank on the motor vehicle, shall comply with the requirements of paragraph F and I of this section. Other than side mounted gasoline tanks on every truck or truck tractor, the date of manufacture of which is subsequent to November 30, 1953, shall comply with the requirements of paragraphs F and I of this section.

***F—Liquid Fuel Tank Construction***

1. **Material**—Material used in the construction of the tank and its fittings shall be suitable for the purpose intended.

2. **Joints**—Joints of the tank body shall be closed only by arc, gas, seam, or spot welding, brazing, or silver soldering.

3. **Fittings**—The tank shall be provided with suitable flanges or spuds for the assembly of all fittings.

4. **Threads**—Threads on all fittings shall be American (National) Standard Taper Pipe Thread or SAE Standard Short Dryseal Taper Pipe Thread. There shall not be less than four full threads in engagements in any fitting.

5. **Drains and Bottom Fittings**—Drains and other bottom fittings shall not extend more than ¾ in. below the lowest part of the tank and shall be designed or guarded to minimize their being torn loose. All drain fittings shall be so designed and located as to permit complete drainage. The drain shall be located in a suitable flange or spud.

6. **Fuel Discharge Line**—The fitting through which the fuel is drawn from the tank shall be located above the normal full line of the tank.

7. **Excess Flow Valve**—When pressure devices are used to force fuel from the tank, means shall be provided to prevent the continued flow of fuel in the event the fuel feed line is broken.

8. **Fill-Pipe Design**—The fill pipe shall be designed and located so as to minimize the probability of its being torn loose in the event of an accident. The fill pipe and vents on any fuel tank having a fuel capacity in excess of 25 gal shall be so designed and constructed as to permit filling at a rate of at least 20 gal per min without spillage.

9. **Air Vent**—Every fuel tank shall be equipped with an air vent of a nonspill type (ball check or equivalent). The air vent may be mounted separately or combined with the filler cap or safety vent.

10. **Safety Vents**—(a) Side mounted fuel tanks having a fuel capacity in excess of 25 gal shall be provided with a fusible safety vent or vents which shall be so designed as to limit the pressure rise in the tank under any fire condition to a maximum of 50 psig. The vent area shall be sufficient to prevent a rise in pressure in the tank of more than 10% of the release pressure of the safety vent or vents when the tank is subjected to a fire of any magnitude. If but one fusible safety vent is provided, it shall be located in the top of the tank; if more than one fusible safety vent is provided at least one shall be in the top of the tank.

(b) All fuel tanks having a fuel capacity in excess of 25 gal shall be provided with means of relieving pressure in the tank due to fire before such pressure would result in the failure of the body, seams, or any bottom opening in the tank.

***G—Liquid Fuel Tank Capacity Markings***—The tank shall be marked with its liquid capacity and shall be provided with means to indicate that it shall not be filled to more than 95% of its total capacity.

***H—Liquid Fuel Tank Identity Markings***—Each tank shall be marked to identify its manufacturer and to indicate the approximate date of manufacture by lot number or otherwise.

***I—Liquid Fuel Tank Installation***

1. **General requirement**—The tank shall be mounted in accordance with the best commercial practice.

2. **Location of fill-pipe**—The nozzle opening in the fill-pipe shall be outside the cab or body and must be so located as to minimize the likelihood of spillage of fuel during the filling process on the exhaust system or battery.

***J—Liquid Fuel Tank Tests***

1. **Drop Test on Corner of Tank**—The tank when filled with water equal in weight to that of its fuel capacity shall withstand without leakage a drop of 30 ft falling so as to strike squarely on one corner on concrete or equivalent surface which shall not rupture under this impact. The fill-pipe and cap, fuel gage sending device, and the air intake and safety vents shall not leak more than 1 oz of water per min as a result of this test.

2. **Drop Test on Fill-Pipe**—The tank when filled with water equal in weight to that of its fuel capacity shall withstand without leakage a drop of 10 ft falling so as to strike squarely on the fill-pipe on concrete or equivalent surface which shall not rupture under the impact. The fill-pipe or cap shall not leak more than 1 oz of water per min as a result of this test.

3. **Safety Vent Test**—The safety vent, or vents, shall limit the rise in internal pressure in the tank to a maximum of 50 psig when the tank is filled to three-fourths of rated capacity with standard fuel and placed in inverted position with the fuel feed outlet connection plugged when an enveloping flame is applied to the tank with sufficient intensity to produce an internal fuel temperature rise of 6 to 8 F per min starting from a fuel temperature of 50 to 80 F. Neither the tank, fill-pipe, fuel gage, air intake vent, nor any other opening except blown fusible plugs shall leak more than 1 oz of fuel per min after having been subjected to these conditions. Other types of tests or calculations may be employed to determine compliance with this requirement if a comparable result is obtained.

4. **Rupture Test**—The tank and all appurtenances including the fill-pipe, cap, fuel gage, and air intake vent shall withstand without rupture an internal hydrostatic pressure of 150% of the maximum at which the safety vent is required to release.

5. **Spillage Test**—At ordinary room temperature the tank when filled to capacity with its normal fuel and turned through an angle of 150 deg from its normal position, with outlet pipe plugged, shall not spill or leak fuel at a rate greater than 1 oz per min. The fill-pipe, cap, fuel gage outlet, air intake vent, safety vent, and any other openings shall withstand this test.

***K—Liquid Fuel Tank Certification***—Every side mounted gasoline fuel tank designed and constructed to comply with these requirements shall be plainly and permanently marked with the date of manufacture and a certification of the manufacturer that it complies with such requirements. The certification shall contain the words "Meets ICC requirements—side mounted gasoline" or words of similar meaning.

NOTE: Side mounted fuel tanks, while not defined in the ICC Regulations, have been defined in the following terms for the purpose of these regulations:

**On Truck Tractors**—Any fuel tank outside the vehicle frame, any part of which tank other than the filling pipe extends beyond the horizontal outline of the bottom of the tractor cab.

**On Trucks**—Any fuel tank, any part of which other than the filling pipe extends outside a horizontal line, parallel to the length of the truck, tangent to the outer surface of the front tire when in the straight ahead position.

# IEL SYSTEMS-TRUCK AND UCK TRACTORS—SAE 5703 JUN95

SAE Recommended Practice

rt of the Truck and Bus Truck Crashworthiness Subcommittee of the SAE Truck and Bus Cab and Occupant Environment Committee, reissued June 1995. Rationale ient available.

*oreword*—This SAE Recommended Practice is a reintroduction of SAE ) which was removed from the SAE Handbook in 1980. The reintroduction efits from many years of industry conformance and testing to Federal Motor ier Safety Regulations as prescribed by the U.S. Department of nsportation Federal Highway Administration Parts *393.65* and 393.67. The ating is a result of the need to introduce the international metric system, and reflects what has been learned from component testing-and reported geld eriences.

his document does not exclude liquid fuel tanks less than 95 L (25 gal) acity (as does the Federal Highway Administration document). This does not ear to cause any hardship on vehicle or component manufacturers since the majority of fuel tanks used in the classes of vehicles covered in the "Scope" ady conform to the performance and test standards required of the liquid fuel s *over 9s* L capacity.

he intent of this document is not only to clarify the procedures and reflect the currently known practices, but also to prescribe requirements in Sections 3 4 that meet or exceed all the corresponding performance requirements of CSR *393.65* and 393.67 that were in effect at the time of issue. However, rence to the regulations should be made on such matters as applicability, kings, and subsequent regulatory changes which are beyond the purview of



1. *Scope*—This SAE Recommended Practice applies to all commercial, self-propelled, or towed motor vehicles which transport property or passengers in interstate commerce in which the gross vehicle weight rating or gross combination weight rating *exceeds* 4550 kg (10 000 lb).

2. *References*

2.1 Applicable Documents-The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J476a—Dryseal Pipe Threads

2.1.2 FMVSS PUBLICATIONS—Available from the Superintendent of Documents, U.S. Government Priming office, Washington, DC 20402.

Federal Motor Carrier Safety Regulations, Title 49, Subparts 390.3. 390.5, *393.65* and 393.67

CFR, FMVSS 571.301 Fuel system Integrity

3. *Definitions*

3.1 Liquid Fuel Tank—A fuel tank containing a fuel that is liquid at normal atmospheric pressure and temperatures.

3.2 Side-Mounted Fuel Tank—A fuel tank located in such a manner that any part extends outside of the vehicle frame rails when looking at the vehiale from a plan (top) view. For purposes of this definition, the fill spout is to be ignored.

3.3 Non Side-Mounted Fuel Tank—A fuel tank which is located totally within the confines of the vehicle frame rails and behind the vehicle's front axle when looking at the vehicle from a plan (top) view. For purposes of this definition, the fffl spout is to be ignored.

3.4 Adapters—Permanent nonremovable devices or means, affixed to the fuel tank for the attachment of fittings.

*35* Fittings—Removable devices affixed to the adapters in the fuel tank, with the exception of the fuel cap, which is not considered a fitting.

*3.6* Family Concept—Once the largest capacity of a fuel tank has been successfully tested, all smaller capacity fuel tanks having similar characteristics such as cross section, material specifications, joining and/or welding, and assembly processes are assumed to be capable of meeting the same requirements of this document.

4. *Requirements—All Fuel Systems*

4.1 Application of This Section-This section applies to systems for containing and supplying fuel for the operation of motor vehicles or for the operation of auxiliary equipment installed on, or used in connection with, commercial motor vehicles.

4.2 Location-Each fuel system must be located on the motor vehicle so that:

*4.2.1* No part of the system extends beyond the widest part of the vehicle;

*4.2.2* No part of a fuel tank is forward of the front axle of a power unit;

*4.2.3* Fuel spilled vertically from a fuel tank while it is being filled will not contact any part of the exhaust or electrical systems of the vehicle, except the fuel level indicator assembly;

*4.2.4* Fill pipe openings are located outside the vehicle's passenger compartment and its cargo compartment;

*4.2.5* A fuel line does not extend between a towed vehicle and the vehicle that is towing it while the combination of vehicles is in motion;

*4.2.6* No part of the fuel system is located within or above the passenger compartment.

4.3 Fuel Tank Installation-Each fuel tank must be securely attached to the motor vehicle.

4.4 Gravity or Siphon Feed Prohibited-A fuel system must not supply fuel by gravity or siphon feed directly to the carburetor or injector.

**4.5 Selection Control Valve Location-If** a fuel system includes a selection control valve which is operable by the driver to regulate the flow of fuel from two or more fuel tanks, the valve must be installed so that either:

4.5.1 The driver may operate it while watching the roadway and without leaving his driving position; or

4.5.2 The driver must stop the vehicle and leave his seat in order to operate the valve.

**4.6 Fuel Lines-Any portion** of a fuel line which extends more than 50 mm (2 in) below the fuel tank or its sump shall be enclosed in a protective housing. Diesel fuel cross-over, return, and withdrawal lines which extend below the bottom of the tank or sump must be protected to minimize damage from impact. Every fuel line must be:

4.6.1 Long enough and flexible enough to accommodate normal movements of the parts to which it is attached without incurring damage; and

4.6.2 Secured to minimize chafing, kinking, or other causes of mechanical damage.

**4.7 Excess Flow Valve—When** pressure devices are used to force fuel from a fuel tank, a device which prevents the flow of fuel from the fuel tank if the fuel feed line is broken must be installed in the fuel system.

*5. **Requirements—Liquid** Fuel Tanks*

**5.1 Application of This Section—Liquid** fuel tanks must meet all the provisions contained in this section, except those liquid fuel tanks designed to carry diesel fuel only need not meet 5.2.5.

**5.2 Construction of Liquid Fuel Tanks**

5.2.1 JOINTS of a liquid fuel tank must be closed by techniques that provide heat resistance equivalent to the parent materials and mechanical securement equivalent to 80% of the parent material. Joints include all the head and body seams and nonremovable adapters affixed to the liquid fuel tank.

5.2.2 ADAPTERS—The liquid fuel tank must have suitable means for the attachment of all fittings. (Refer to Section 3.)

5.2.3 THREADS—If fittings and their corresponding adapters are of the threaded type, the threads must be as specified in SAE J476a, except that straight (nontapered) threads may be used on fittings and their corresponding adapters which have integral flanges and use gaskets for sealing. At least four full threads must be in each threaded fitting and corresponding adapter.

Metric threads are allowable provided they are equivalent in that tbey meet the same criteria as other threaded fittings and their corresponding adapters as described previously.

5.2.4 BOTTOM FITTINGS—If there is a bottom fitting installed, it must not extend more than 19 mm (0.75 in) below the lowest part of the liquid fuel tank or sump.

5.2.5 FUEL WITHDRAWAL FITTINGS AND ADAPTERS—All liquid fuel tanks must have fuel withdrawal fittings and their corresponding adapters located such that they are above the normal level of fuel in the tank when the tank is full and resting at a normal installed attitude, except for those liquid fuel tanks designed to carry diesel fuel only. Any liquid fuel tank designed to carry any of several fuels must have a notice near all adapters below the previously defined liquid level stating 'for diesel use only." Drain adapters are exempt from this provision.

5.2.6 FILL PIPE

*5.2.6.1* The fill pipe and vents must permit filling the liquid fuel tank with fuel at a rate of at least 76.0 L (20 gal) per minute without fuel spillage.

5.2.6.2 Each fill pipe must be fitted with a cap that can be fastened securely over the opening in the fill pipe.

5.2.7 PRESSURE RELIEF VENTING SYSTEM—Each liquid fuel tank must have a venting system which, in the event the tank is subjected to fire, will prevent internal pressure from rupturing the tank.

5.2.8 PRESSURE RESISTANCE—Each liquid fuel tank must be capable of withstanding an internal hydrostatic pressure equal to 150% of the maximum internal pressure reached in the tank during the Pressure Relief Venting System Test specified in 5.3.1 of this section, or 276 kPa (40 lb/in$^2$), whichever is greater. The use of the Family concept *is* appropriate for the purpose of this test. (Refer to "Family concept" in Section 3.)

5.2.9 OVERFILL RESTRICTION—A liquid fuel tank must be constructed such that the liquid fuel tank cannot be tilled with a quantity of fuel that exceeds 95% of the tank's liquid fill capacity when filled at rest on a horizontal surface and while being fueled at the rate of 76.0 L (20 gal) per minute.

5.2.10 AIR VENT—Each liquid fuel tank shall be equipped with an anti-spill air vent. Its installation must be such that the air vent will permit fuel to expand into the available 5% air space, without activating the shut-off function of the air vent while the tank is at rest on a horizontal surface. Momentary shut off due to fuel surge while filling is permitted as long as the vent returns to an "open" condition.

**5.3 Liquid Fuel Tank Tests**—The specified tests are a measure of performance only. Manufacturers and users may use any alternative procedures which assure that their equipment meets the required performance criteria.

The family concept may be utilized for these tests. (See Section 3, Definitions.)

Side-mounted liquid fuel tanks must be capable of passing all of the following tests. Non side-mounted liquid fuel tanks need not be capable of passing 5.3.4 "Drop Test" and 5.3.5 "Fill Pipe Test."

5.3.1 PRESSURE RELIEF VENTING SYSTEM TEST

*5.3.1.1 Procedure*—Fill the tank to three-fourths of its liquid fill capacity with the fuel it is designed to carry. In the event it is designed to carry any of several fuels, use the most volatile fuel. Seal all fuel feed, return and equalizing inlets and outlets, but leave the air vent, pressure relief vent and filler cap installed. Invert the tank 180 degrees from its normal installed attitude, and suspend it within 2/3 m (2 ft) above the top edge of a pan large enough to extend beyond the tank on all sides in plan view and deep enough to hold the entire fuel load in the tank. Provide means to direct fuel exiting the tank into the pan.

With the fuel initially between 10 and 27 °C (50 and 80 °F) apply a fire to the tank so that the temperature of the fuel rises at a rate of not more than 8 °C (8 °F) per minute until the pressure relief vent activates, and thereafter rises at a rate of not less than 5 °C (8 °F) per minute. Continue the test until the fuel tank is empty or until no further pressure rise is possible in the tank.

*5.3.1.2 Required Performance*—Neither the tank nor any of its fittings may leak visibly more than 28 g (1 oz) of fuel by weight per minute during the test (separate drops are deemed to be less than 28 g (1 oz) per minute if evidenced by a steady stream of fuel prior to activation of the pressure relief vent. Neither the tank, body, seams, nor fittings (except the pressure relief vent) may rupture due to internal pressure. Pressure in the tank throughout the test must not exceed 310 kPa (45 lb/in$^2$) gauge despite the intensity or extent of the fire. Momentary pressure spikes due solely to combustion in the tank itself are excepted. The tank material must not weaken to the point of failure below the liquid level. Both the leakage and the pressure requirements must be independent of whether or not the flame directly impinges the pressure relief vent or other portions of the tank, components, and fittings. All plugs, fittings, etc., used to seal the test tank in addition to the air vent, pressure relief vent, and filler cap must be able to withstand the same direct flame as does the fuel tank assembly.

5.3.2 FUEL TANK ASSEMBLY LEAK TEST

*5.3.2.1 Procedure*—Fill the fuel tank to 95% of its liquid fill capacity with the fuel it is designed to carry or an equivalent fluid. If the tester deems this procedure too hazardous, Stoddard solvent may be substituted. The test fluid must be between 10 and 27 °C (50 and 80 °F). Install the fill cap, air vent, and turn the tank through any angle in any direction about any axis from its normal installed attitude.

As a second part of the previous test, turn the tank 90 degrees around the longitudinal axis as it may be mounted on a vehicle, introduce air at 28 kPa (4 lb/in$^2$) and while it is pressurized, continue rotation about the same axis to 180 degrees.

5.3.2.2 *Required* ***Performance***—The entire liquid fuel tank assembly must not leak more than 28.0 g (1.0 oz) by weight of fuel per minute in any static position the tank could assume during the test.

5.3.3 AIR VENT LEAK TEST

*5.3.3.1 Procedure*—Mount the air vent on an open container. Orient the container so that the vent axis is at any angle from upright to inverted. Introduce fuel the vent is designed to contain or an equivalent fluid into the container. Stoddard solvent may be substituted. While the vent is fixed in orientation, raise the liquid level in tbe container at a rate of not mote than 0.6 cm (1.5 in) per second until the vent is fully submerged.

*5.3.3.2 Required* ***Performance***—The vent must not leak more than 28 g (1 oz) by weight per minute when the liquid in the container is positioned at any level it may take during the test.

5.3.4 DROP TEST

5.3.4. I *Procedure*—Fill the tank with a quantity of water having a weight equal to the weight of the maximum fuel load of the tank and drop the tank 9 m (30 ft) on to an unyielding surface so that it lands squarely on an exposed outboard corner. In the case of a rectangular tank, the outboard corner is defined as one of the four corners farthest distant from the vehicle frame from which the tank is mounted. The corner of a round tank is defined as a point along the circumferential edge of the tank.

NOTE—The fill pipe and cap are not to be subject to direct impact as there is a separate test required in 5.3.5.

5.3.4.2 *Required* ***Performance***—The liquid fuel tank assembly may not more than a total of 28.0 g (1 oz) by weight of water per minute.

5.3.5 FILL PIPE TEST

*5.3.5.1* Procedure--Fill the tank with a quantity of water having a weight al to the weight of the maximum fuel load of the tank and drop the tank 3.1 (10 ft) onto an unyielding surface so that it lands squarely on its fill pipe. The ude of the tank in this test should be such that a longitudinal axis passing ough the center of the till cap and through the center of the intersection of the pipe and the tank is perpendicular to the impact surface.

*5.3.5.2 Required Performance*—The liquid fuel tank assembly may not more than a total of 28.0 g (1 oz) by weight of water per minute.

**5.4 Certification and Markings**—The SAE does not require certification /or markings for liquid fuel tanks manufactured to this document, except that 3.2.5 it requires that tanks manufactured for both diesel and gasoline use must e a notice near all adapters located below the normal full liquid level line ing "For diesel fuel only."

The United States requires certification and markings for fuel tanks manufactured for use in the U.S. as referenced in 2.1. As of April 1994, those regulations require permanent and legible markings as follows:

Name of manufacturer and means of identifying the facility at which the tank was manufactured;

Month and year of manufacture;

Liquid capacity;

Warning against filling it to more than 95% of its liquid capacity;

A certificate that the fuel tank conforms to the rules pertaining to side-mounted or non-side-mounted fuel tanks.

NOTE—It is the user's responsibility to see that fuel tanks manufactured for use in other countries also meet the requirements or practices, if any, of each country in which the fuel tank is used.

*6. Optional* ***Marking***—In addition to any legally required markings such as in 5.4, the following marking may be included if a fuel tank is manufactured to SAE J703:

"Meets SAE J703."

# TANDARD FOR PROTECTIVE COVERS FOR ASOLINE FUEL LINE TUBING—SAE J2027 JUN98

S A E Standard

t of the SAE Fuel Lines and Fitting Standards Committee approved June 1994 and completely revised June 1998.

*Scope*—This SAE Standard includes performance requirements for protec- covers for flexible, non-metallic fuel tubing, Ultimate performance of the ctive cover may be dependent on the interaction of the fuel tubing and pro- ive cover. Therefore, it is recommended that tubing and cover combinations sted as an assembly, where appropriate, to qualify to this document.

1.1 This document is intended to provide guidance in regard to key perfor- ce parameters for protective covers for fuel tubing. This document is designed llow selection of predetermined performance levels for these parameters.

1.2 The engineer may select a specification by the use of a line call-out des- ation, which will denote the pertinent characteristics of the cover material and/ he tube/cover assembly and their corresponding performance criteria. The ineer is not required to select every characteristic, but only those deemed portant to the application. Characteristics not covered by this document and med important to the engineer should be added using "Z" suffixes, with a iled description for each "Z" on the part drawing.

1.3 This document may involve hazardous materials, operations, and equip- nt. This document does not address the safety problems associated with its . It is the responsibility of the user of this document to consult and establish opriate safety and health practices, and determine the applicability of regula- limitations prior to use.

*References*

2.1 Applicable Publications—The following publications form a part of specification to the extent specified herein. Unless otherwise indicated the lat- revision of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, rendale, PA 15096-0001.

SAE J400—Test for Chip Resistance of Surface Coatings

SAE J1960—Accelerated Exposure of Automotive Exterior Materials Using a Controlled Irradiance Water-Cooled Xenon-Arc Apparatus

SAE J2236—Standard Method for Continuous Upper Temperature Resistance

SAE J2260—Non-Metallic Fuel System Tubing with One or More Layers

2.1.2 ASTM PUBLICATIONS—Available from ASTM, LOO Barr Harbor Drive, st Conshohocken, PA 19428-2959.

ASTM D 412—Test Methods for Rubber Properties in Tension

ASTM D 471—Test Method for Rubber Property—Effect of Liquids

ASTM D 635—Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

ASTM D 638-Test Method for Tensile Properties of Plastics

ASTM D 1149—Test Method for Rubber Deterioration—Surface Ozone Cracking in a Chamber (Flat Specimens)

ASTM D 1171—Test Method for Rubber Deterioration-Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)

ASTM D 3182—Recommended Practice for Rubber-Materials. Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets

ASTM D 3183—Practice for Rubber—Preparation of Pieces for Test Purposes from Products

2.1.3 ISO PUBLICATION—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 6495—Rubber hoses—Determination of abrasion resistance of the outer cover

3. *Classification*

3.1 Type—Protective covers will be classified as either elastomeric or non-elastomeric. Rigid classification criteria are difficult to establish, but classification of most covers will be obvious.

3.1.1 SAE J2027a—ELASTOMERIC COVERS—Normally, covers formed from an organic material with a single continuous structure. An example would be a cover consisting of an extruded tube of rubber or plastic which exhibits elastic characteristics.

3.1.2 SAE J2027b—NONELASTOMERIC COVERS-Normally, covers formed from nonelastic, inorganic materials such as fiberglass, but may be formed from organic fibers. In general, nonelastomeric covers can be distinguished based on a construction of a number of filaments which have been matted, woven, or braided to form the cover. An example would be a braided fiberglass sleeve.

3.1.3 NOTE—If there are both elastomeric and nonelastomeric elements in the cover construction, classification shall be based on the dominant element in the construction.

3.2 Line Call-Outs—A line call-out, which is a specification, shall contain: the document designation, the cover type, the performance characteristics, and the performance requirements. The following is an example of a line call-out:

SAE J2027a 1B 2C 4B 5D 6E 8A

where:

SAE J2027 = document designation

a = Elastomeric cover

1 B = Thermal Resistance, 12 1 °C minimum continuous service temperature

2C = Resistance to Combustion, 10 s maximum burn time

4B = Stone Impingement Resistance, 6 cycles, minimum, to wear through

5D = Cold Temperature Impact, -34 °C maximum

6E = Bum-Through Resistance, 5 min. minimum, to pressure loss

8A = Ultraviolet Resistance, 1250 $kJ/m^2$ exposure

33 See Table 1 for performance and classification requirements.

4. *Sample* ***Preparation***—The preparation of specimens for testing under this document shall conform to the expected procedures for full-scale manufacturing of the fuel line/cover assembly. A sample size of eight is required for each test. Except where otherwise noted, fuel tine tubing/cover samples are required for testing.